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ABSTRACT

As more and more institutions and companies in Canada develop online learning content, the importance of learning objects and the metadata used to describe them becomes clear. EduSource has brought together Canada's leading experts, researchers and practitioners in the field of e-learning for the purpose of defining and testing a world-class infrastructure for learning object repositories (LOR) and to produce a Repository in a Box prototype that will include metadata guidelines, software tools, hardware specifications, best practices and methods for generating communities of use that would allow any organization to build and connect its own repositories. (Author)

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eduSource: A pan –Canadian learning object repository

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Abstract: As more and more institutions and companies in Canada develop online learning content, the importance of learning objects and the metadata used to describe them becomes clear. EduSource has brought together Canada's leading experts, researchers and practitioners in the field of E-Learning for the purpose of defining and testing a world-class infrastructure for learning object repositories (LOR) and to produce a Repository in a Box prototype that will include metadata guidelines, software tools, hardware specifications, best practices and methods for generating communities of use that would allow any organization to build and connect their own repositories.

Summary

The eduSource project is a pan-Canadian collaborative project to create a testbed of linked and interoperable learning object repositories. The project is providing leadership in the ongoing development of the associated tools, systems, protocols and practices that will support such an infrastructure. The primary delivery mechanism for this testbed will be the broadband Internet, and in particular CA*Net 3/4. This project is based on national and international standards; it is fully bilingual; it will be accessible to all Canadian including those with disabilities; and it will share and disseminate its findings across Canada and internationally. Each of the partners and their associates are bringing considerable resources to the project. Collectively the contributions of the partners amount to $5,280,000 of the total project value of $9,830,000, CANARIE is contributing up to $4,500,000.

To simplify its activities, eduSource has six designated primary partners who will lead this work – Athabasca University, the Netera Alliance, (New Brunswick Distance Education Network (NBDEN), the New Media Innovation Centre, Téléuniversité du Québec, and the University of Waterloo – with the Netera Alliance serving as the lead contractor. In addition it will include a host of associates in the private and public sector representing learning institutions from across the country.

EduSource takes advantage of, and enhances, the capabilities of each of its members in building a comprehensive LOR implementation infrastructure. NBDEN will work with the NewMIC Foundation to explore the development of Repository Content. NBDEN will also work with TeleEducation NB, the National Research Council, and private sector partners such as RightsMarket Inc. to investigate Digital Rights Management for LOR's. Télé-université with le Centre de recherche LICEF and the Advanced Technologies for Learning Unit of the University of Alberta will provide a testing and evaluation framework for the project. Athabasca University will lead in the ongoing development of the CanCore metadata application profile. Télé-université will coordinate the integration and development of software packages such as Explor@ - II, CAREO (Campus Alberta Repository of Educational Objects), ALOHA (from the Learning Commons at the University of Calgary) and SPLASH (from the POOL project) and lead the development of new software packages. Netera and NewMIC will continue their work in hardware and network integration. The University of Waterloo will contribute its knowledge of and international collaborations in community building, as well as its expertise developed in the CANARIE Learning

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Program's PLIANT (**Partnerships for Learning, Innovation and Technology**) project. Netera will provide project management, coordination and communications for the project as well as examining new Business and Management Models.

Project Objectives

The primary objective of the project will be the design and testing of a prototypical but functional, national learning object repository infrastructure and the development of specifications and tools for a "Repository in a Box" that can be shared with organizations across the country. This will be accomplished by bringing together Canada's leading experts, researchers and practitioners in the field to share best practices for the large-scale, country-wide deployment of a network of learning object repositories.

In this context, the project team has identified four broad goals for the project:

1. Tto promote and refine a repository metadata framework through the ongoing development of the CanCore protocol;

2. To support experimental research in key areas such as pedagogy, accessibility, protocols, network engineering, hardware integration, quality of service, security, rights management, content development and software applications;

3. To implement a national testbed to investigate processes such as peer review, content repurposing, user support, professional development and content transactions; and

4. To communicate and disseminate its findings through cooperation and partnership with other federal and provincial agencies, institutions and the private sector.

To meet these goals, the eduSource project has identified a number of specific objectives:

1. *It will address and examine issues of interoperability by connecting a critical , mass of learning objects housed in repositories across the country.*
   Specifically, it will first link together existing collections of learning objects such as BELLE's Alexandria Repository and the Math Resources website at Simon Fraser University and secondly it will provide the tools for other communities, such as SavoirNet and CIRTA (Centre interuniversitaire de recherche sur le téléapprentissage) in Quebec to create and connect their own content and repositories to this pan-Canadian network. In this manner a sufficient number of learning objects of various types can be created, adapted, packaged and tested.

2. *It will play a leadership role in developing and promoting national and international standards.*

   Already eduSource members participate in a variety of IMS, IEEE and other international working groups. Members are part of an international network working to develop and implement the Educational Modeling Language. This new project will provide a framework for these experts to continue to contribute to the ongoing development of internationally recognized metadata specifications.

3. *It will develop a blueprint for the rights management of learning objects.*
   The objective here is to design a rights management structure, built on internationally recognized standards, for use by the repositories participating in this national initiative and to integrate this work with the project's software tools.

4. *It will link and integrate the development of repository software programs.*
   In the first phase of the CANARIE E-Learning Program eduSource partners and associates produced a host of valuable software tools for building repositories. These include Explor@ - II for managing resources and repositories and integrating learning objects within courses and learning events; CAREO for searching and building centralized repositories; ALOHA for metatagging objects in CanCore; and SPLASH for creating peer-to-peer repository networks. The

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objective of this phase of the work is to integrate and extend those packages to provide a comprehensive suite of tools to build, link and use repositories.

5. *It will create a physical testbed of servers linked together through CA*net 4.*
As in Software Development, the focus of this objective will be in integrating existing testbeds. The BELLE, POOL, CanLOM, APCCC (Atlantic Provinces Community College Consortium) and SavoirNet projects are some of the existing or proposed repositories that will be molded into a single, shared network for the creation, management and distribution of learning objects using both client-server and peer-to-peer applications..

6. *It will build a bilingual pan-Canadian community of practice.*
Under the leadership of Tom Carey at the University of Waterloo, the BELLE, PLIANT, POOL and SavoirNet communities of use are being linked together to form a critical mass of instructors, teachers, technology coordinators, instructional designers and content producers. All partners have made a commitment to provide materials in both official languages. Canada can and should play a pivotal role in ensuring that multilingual capabilities are an inherent part of LOR development.

7. *It will examine new business and management models for object repositories.*
EduSource is developing models for the ongoing sustainability and commercialization of its testbed. In particular, the leadership role that Canada is playing in this area will be investigated for its potential to generate international export opportunities.

8. *It will develop a communications plan for the dissemination of these results.*
A comprehensive plan will be designed to speed the flow of information between eduSource partners and associates as well as raising awareness throughout the country about the importance and value of this work.

9. *It will accomplish these goals within the context of a comprehensive program of evaluation and feedback.*
Evaluating the effectiveness of learning objects in educational environments is critical to the success of this repository project. Based on the experiences of the UICEF's LORIT Laboratory at Télé-université and the Advanced Technologies for Learning Unit of the University of Alberta, the project will ensure consultation and input from a broad spectrum of educators and learners from across Canada.

10. *It will make certain that that these repositories will be accessible to all Canadians and particularly to those learners with disabilities.*
Through an alliance with Jutta the Adaptive Technology Resource Centre, at the University of Toronto (ATRC), eduSource will be linked to and compliant with the Centre's guidelines for accessibility. EduSource will work with them through their Barrierfree On-line Learning Exchange or BOLE project in order to make our network of repositories accessible.

Project Description

Canada's recently announced Innovation Strategy is predicated on an ever-increasing supply of well-educated and skilled workers in all parts of the economy and in all parts of the country. Learning object repositories are the first step in ensuring that this demand can be met. Individual provinces, learning institutions and even the private sector are all capable of developing their own separate and discrete repositories but the value of these projects grows exponentially when they are connected together.

EduSource will be designed around a series of complementary and interwoven work packages. What holds these pieces together is the idea of developing and testing a shared prototypical "Repository in a Box." Each package has been designed to support this concept and taken together they provide much more than just a testbed for a network of linked repositories – in effect, they provide the blueprint for others all across Canada to create a proliferation of repositories that can all work and communicate together. Each of these packages is described in detail below.

Repository Content Development

Package Managers: NBDEN and NewMIC Foundation
Key Participating Partners: University of Waterloo; Télé-université

The key to this package is to develop a critical mass of content to test the capabilities of the proposed network. This will be accomplished by a multi-part strategy. The package managers will develop and provide the interfaces, templates and protocols necessary to connect existing and developing learning object repositories across Canada and internationally and ensure interoperability.

Secondly, content from all the project partners and associates will be repurposed. In association with the Community Building partners, learning objects will be authored by diverse communities and institutions from across Canada.

Thirdly, using the content developed in stages one and two, learning objects of various types will be created, adapted, and tested. This includes the storage, indexing and segmentation of media types ranging from text to Java Applets; the development of archival standards for digital masters; and an evaluation of the effectiveness of the delivery of these objects through a variety of means including broadband, medium band and satellite networks.

NBDEN and its partners will use the CanCore specification to build the next generation of CanLOM – the pan-Canadian Learning Object Metadata directory, which will be based on the TeleCampus. CanLOM is not a learning object repository, but rather a database containing the metadata necessary for the exchange and interoperability of learning objects housed in repositories across Canada and in other countries. Partners are working together to present a comprehensive strategy for the widespread adoption and implementation of the CanCore metadata profile through CanLOM and through repository projects across Canada.

Digital Rights Management
Package Managers: NBDEN with NRC

Based on the explorations and research of the National Research Council, a digital rights management (DRM) approach will be developed for the project. This package will begin with a comprehensive survey of the literature in the fields of commerce and information management on the current state of DRM theory and technology and will look at emerging international standards such as the Open Digital Rights Language (ODRL).

Based on this research a series of recommendations regarding DRM will be prepared and presented. These will include an XML (Extensible Markup Language) DRM schema which can be used as a standard complement to the CanCore profile. These components will be used to design a rights management structure for repositories participating in this national initiative. Mechanisms for using this specification will be integrated into the project's suite of software tools.

Testing and Evaluation
Package Managers: Netera and Télé-université

Partners will implement a project evaluation strategy designed to maximize learning, knowledge accumulation and dissemination and knowledge transfer. This work will be accomplished through well-established stages such as Outcome Definitions, Needs Assessment, Formative Evaluation, Summative Evaluation and Learning from the Collaborative Process. A summative evaluation will assess the impact of the project on practice within the participating organizations. It will also assess the project's success at

meeting the initial project goals. Data will be gathered through extensive interviews with key partners, associates, funders, surveys of end users and functional review of products produced during the project.

Despite the popularity and potential of collaborative funding models with government agencies, there has been little systematic study of their efficacy and little awareness of potential problems and solutions that will better ensure successful innovation. EduSource will develop both theoretical and practical models to inform future projects. Using constant comparative analysis of interview transcript data, minutes of meetings, project documentation and investigator observation, the researchers will build theory that identifies the most effective type of collaborative organization, barriers and motivators for collaboration and types of organizational structure most conducive to effective collaboration both within the partnering organizations and of the collaborative organization.

Metadata Development
Package Managers: Athabasca University and NBDEN
Key Participating Partners: Télé-université

Metadata is what separates repositories from the chaos of the World Wide Web. In this respect, the development of the CanCore metadata profile is one of the most important deliverables of the entire E-Learning Program. EduSource will build on this success and further Canada's leadership in this area. The partners are developing, extending and reinforcing the CanCore, including the development of a French language version.

Partners will work on extensions to the specifications to integrate distance learning ontologies derived. The actual LOM relational database implementation within the Explor@-II system will complement and directly aid in the implementation of the CanLOM learning objects metadata directory.

EduSource is not merely conforming to internationally recognized metadata specifications, but its members are actively engaged in setting those standards. This project acts as a springboard for Canada to play a prominent role in this area.

Software Development
Package Manager: Télé-université
Key Participating Partners: Athabasca University; NBDEN; NewMIC Foundation; Learning Commons, University of Calgary (in association with Netera)

The partners are developing an integrated suite of software tools for the implementation and management of learning object repositories. These software tools will form the foundation of the pan-Canadian repository network and their development will be coordinated across various institutions. Wherever possible the project will use open source solutions to ensure the adoption and use of these tools across a full spectrum of Canadian and international educational organizations.

A crucial dimension of this work will be the integration of existing software tools developed during the first phases of the E-Learning Program. These include the POOL project's SPLASH for the creation of peer-to-peer networks of repositories; Explor@ II for the management of repositories and resource integration into courses; CAREO for the searching and creation of centralized repositories; and ALOHA from the Learning Commons at the University of Calgary for the metatagging of learning objects. By making these tools work together and augmenting them with some strategic software 'bridges', eduSource will provide a complete set of repository building tools.

But eduSource will also move into new areas of research and development and in particular it will try to harness the emerging capacity of the Semantic Web and Web Services to facilitate teaching and learning. CANARIE projects to date have focused on

the formal description, tagging and distribution of educational objects. While this is an important first step, it is well known that successful learning experiences are dependent upon many other factors besides availability of content. Recognizing this limitation a number of researchers have developed educational modeling languages (EML) that formally describe other critical components of the educational transaction. Most importantly EML from the Dutch Open University is expressed in formalized notation (using XML) to facilitate search, retrieval and automatic application of this knowledge on the semantic web by both humans and autonomous agents. The ADISA implementation of the MISA instructional methodology, built by Télé-université's Cogigraph also provides an educational modeling language as a set of XML descriptions that will be compared with EML and possibly combined through an international collaboration with the Dutch Open University

In this context, the software team will develop tools for Repository Interoperability and Development, Knowledge and Information Management, and Facilitating Teaching and Learning.

Hardware Integration

Package Managers: Netera and NewMIC Foundation

Partners will work together to develop a hardware specification for learning object repositories and to create a physical testbed for a large-scale, cross-country implementation trial of learning object repositories using Ca*net 3/4. This work will build on, enhance and integrate existing servers established through CANARIE projects.

The national testbed will be designed to accommodate servers from various vendors and of various sizes, capacities and operating systems as well as exploring different architectures including both peer-to-peer and centralized server models. In all cases this package will be informed by the principles of open systems and interoperability.

The primary delivery mechanism for this network will be the broadband Internet and in particular CA*net3/4 but it will also investigate the delivery of learning objects by other means as well. This will include the commercial Internet and wireless and satellite systems and the use of caching servers and other devices to enhance delivery and performance.

Business and Management Models

Package Manager: Netera

Key Participating Partners: NBDEN; Télé-université; University of Waterloo

During the course of this project, a business and management strategy will be advanced. To this end a variety of funding models will be developed and assessed. These would include memberships, subscriptions, support and service contracts, licences and pay-per-use. This work will be closely coupled with the Digital Rights Management Package.

This work-package will also explore the sustainability of LOR infrastructures between and within educational institutions. Investigations will be made into how learning organizations independently and separately coordinate resources (labour, equipment) to support the creation of educational objects, what challenges exist, and how to redesign organizational processes to engender the long-term sustainability of LORs in education.

The long-term viability of these networks depends on communicating their value and importance to educational institutions, government agencies and the general public. Learning organizations need to understand that repositories are the foundation of online learning and that lessons, modules and courses cannot be delivered through the Internet without a robust repository architecture. The success of eduSource's business model depends on both its testbed and the effectiveness of its communications plan in disseminating its results.

Community Building
Package Manager: University of Waterloo
Key Participating Partner: Netera

The partners will develop networks of exemplary Canadian communities for the design, development, evaluation and exchange of learning objects and these will be informed by the communities of use established by other collaborative projects. In the post-secondary domain, these networks of communities will demonstrate the scalability of online subject area communities to achieve the following objectives:

- Foster collaborations across Canada among community members
- Extend the quality and quantity of learning objects that are developed and re-used
- Enhance understanding and expertise about the design, implementation and use of learning objects
- Establish a distinctive Canadian area of expertise in the international learning object realm.

- Faculty members at universities and colleges are critical to the development of robust networks of communities. Project partners will develop exemplary proto-type networks of discipline-specific online communities to integrate local collaborations within their larger communities of use and link them to eduSource's pan-Canadian network of repositories.

Project Management, Co-ordination and Communications
Package Manager: Netera
Key Participating Partners: All

In consultation with all its partners, the Netera Alliance Inc. is providing project management, accounting and administration for the project as well as fulfilling the reporting requirements as stipulated by CANARIE. cannot be over-emphasized that the success of large-scale projects with multiple partners spread across the country depends on a strong management team.

Project Team

The eduSource team is built on the foundation of the CRAG (Canadian Repository Action Group) which was formed in the summer of 2001 to provide a forum for ongoing collaboration between Learning Object Repository projects.
The members presently include the following:

- Athabasca University (Alberta)
  - Campus Alberta Repository of Educational Objects
  - Distance Education Projects and Technological Help

- New Brunswick Distance Education Network Inc. (NBDEN)
  - TeleEducation NB
  - Atlantic Provinces Community College Consortium
  - Université de Moncton
  - E-com inc.

- The National Research Council of Canada (NRC)

- Netera Alliance (Alberta)
  - Learning Commons (University of Calgary)
  - Advanced Technologies for Learning (University of Alberta)
  - Callisto
  - Telesat
  - RightsMarket
  - Antarcti.ca.

- New Mic Foundation (New Media Innovation Centre) (BC)
  - Simon Fraser University (Surrey)
  - TelesTraining Inc.
  - C2T2 (Centre for Curriculum Transfer and Technology)
  - BC Institute of Technology

- Téléuniversité du Québec
  - CIRTA
  - LICEF
  - Technologies Cogigraph Inc (TCI)
  - Canal Savoir
  - ETI (Ecole de technologie de l'information)
  - Bell-Technomedia
  - Ecole Polytechnique,

- University of Waterloo

Summary

EduSource is a comprehensive project that ties together various work packages and creates synergies between its partners and associates. All of the partners are Canadian organizations and meaningful work will be carried out in every region of the country. Moreover each partner brings unique skills to the project and the work packages have been organized to ensure that those skills bolster and complement one another. For example, CanCore guidelines are developed in Alberta through Athabasca University but implemented in the CanLOM metadata repository in New Brunswick and in Explor@ in Quebec. In fact, the wide-scale adoption of CanCore demonstrates how the principles of interoperability and open systems have guided our previous projects and are the foundation of our present work together.

Because the project builds on and integrates pre-existing repository work by experienced project teams, eduSource can ensure the soundness of its methods and the feasibility of the technologies involved. In addition not only are eduSource members aware of the best national and international standards, such as CanCore, they are helping to create those standards. All of the partners are connected to CA*net 3 and have helped develop the applications such as videoserving and videoconferencing that exploit its unique strengths. The project addresses issues of accessibility through its partnership with the Adaptive Technology Resource Centre and its Barrierfree On-line Learning Exchange or BOLE project.

The expertise of the team and the members' experience in collaborative product development are powerful indicators that eduSource will be beneficial to the future of the Canadian economy not only through the exporting and commercialization of its results, products and expertise to a growing global market, but also through the significant competitive advantage it will impart to Canada and Canadians through the effective exploitation of broadband networks for the delivery of education and training.

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BOLE	www.barrierfree.ca/
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CanCore	www.cancore.ca
CAREO	www.careo.org/
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Cogigraph (TCI)	www.cogigraph.com
DEPTH	depth.athabascau.ca/
EML	eml.ou.nl/
Explor@	www.licef.teluq.uquebec.ca/exploradem o/
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IEEE LOM	ltsc.ieee.org/wg12/
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LICEF	www.licef.teluq.uquebec.ca/
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